PATENT SPECIFICATION (11) 1219921

1219921

DRAWINGS ATTACHED

(21) Application No. 3265/68 (22) Filed 22 Jan. 1968

(31) Convention Application No. 612154 (32) Filed 27 Jan. 1967 in

(33) United States of America (US)

(45) Complete Specification published 20 Jan. 1971

(51) International Classification D 01 d 5/00

(52) Index at acceptance

B5B 352 35Y 401 409 510

D1R 1

(54) METHOD AND APPARATUS FOR PNEUMATICALLY OR HYDRAULICALLY DEPOSITING A NON-WOVEN WEB STRUCTURE

(71) We, MONSANTO COMPANY of 800 North Lindbergh Boulevard, St. Louis, Missouri, United States of America, a corporation organised and existing under the laws of the State of Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

Nonwoven webs comprising multifilament varns or strands hereinafter referred to as strands, are commonlv formed bv withdrawing said strands from a source of supply, for example the spinneret of a spinning machine or feed rolls and supply bobbins, by means of an aspirating jet and then depositing the strand at high velocity onto a moving surface. In the production of nonwoven products having a substantial width there must be provided either a plurality of aspirators for depositing a plurality of strands in a random manner upon the moving surface or there must be provided a means to transverse the aspirator jet over the width of the product to be produced.

When depositing yarn from a conventional aspirator on to a collecting surface, the filaments will spread out within the confines of the aspirated free air jet boundary. However, the filament distribution in the jet stream is not uniform, probably due to the velocity distribution generated by the aspirator. Consequently, a web deposited on a moving surface from a fixed position aspirator is parabolic in section with more filaments being deposited in the center thereof.

In the conventional practice a fixed aspirator jet situated a distance of one to three feet from the collecting surface normally provides a web width of from 2 to 8 inches even though the filaments may have been previously given a static charge to facilitate dispersion. Thus, it can be seen that to produce a nonwoven web having a width of several feet would require several fixed aspirators having individual sources of supply strands. To obviate the necessity of utilizing a large number of jets it becomes necessary to mechanically traverse the aspirating means. However, when the aspirator means is mechanically traversed the mechanism required to facilitate traversing of the yarn is unduly complicated and cumbersome with attendant difficulty in achieving the requisite uniform traversing velocity and instantaneous reversals of the mechanism mass at the traverse end points. Traversing the aspirator jet also results in a continuous change in the angle of the multifilament strand with respect to the entrance aperture of the aspirator which adversely affects the product quality.

With the above cited problems in mind it is therefore an object of the present invention to provide, in combination, a fluid operated aspirating and traversing mechanism.

Another object of this invention is the provision of a method for producing uniform nonwoven products.

Yet another object of this invention is the provision of a strand forwarding and traversing means employing no moving parts.

Still another object of this invention is the provision of a strand drawing, forwarding, and traversing apparatus utilizing fluid dynamic principles of operation.

One embodiment contemplated for this invention comprises, in combination, a fluid operated aspirating and traversing means for drawing, forwarding, and traversing a multifilament strand positioned above a continuously moving surface for depositing said strand in a random manner whereby uniform nonwoven products having predetermined widths and thicknesses may be obtained.

The method of this invention comprises, in general, the utilization of the combined aspirating and traversing means whereby a strand, preferably forwarded from the spin-

[*Price 5s. 0d. (25p)*]

neret of a spinning machine, is drawn by the high velocity jet or stream of fluid of the aspirator. Subsequent thereto the aspirating jet or stream of fluid forwards the yarn into the traversing zone of the apparatus wherein the fluid jet stream envelops the strand whereby the high velocity stream of fluid upon discharge from the aspirating zone systematically deflects the yarn in a reciprocating manner by means of two diametrically opposed control fluid jets, and whereby the strand is alternately propelled toward one side onto a surface and then toward the other side in the form of a uniform nonwoven web comprising randomly disposed, drawn continuous filaments. Deposition of the yarn may preferably be aided by a suction chamber located underneath the surface. The surface may be a continuously moving foraminous surface.

The specific nature of the invention, as well as other objects, uses and advantages thereof, will clearly be evident from the following description and the accompanying drawing in which:

Figure 1 is a pictorial view depicting the preferred embodiment of the nonwoven web forming apparatus employed for carrying out the invention,

Figure 2 is a sectional view through the combination aspirator and traverse mechanism showing a particular arrangement of the elements taken along the line 2—2 of Figure 1,

Figure 3 is a bottom plan view of the apparatus showing a configuration of the traversing means taken along line 3—3 of Figure 1; and

Figure 4 is a sectional view through the aspirating zone taken along the line 4—4 of Figure 2.

Referring now to the drawings, and particularly Figures 2, 3 and 4, there is shown a particular embodiment of the combination aspirating and traversing mechanism which comprises a housing body 10 having provided integrally therein an annular chamber 12 and a diverging cavity 13 which are interconnected by passageway 14. The vertical length of the diverging wall of chamber 13 is preferably approximately 4 to 6 times the diameter of passageway 14. The chamber 12 is enclosed by a body cap 15 which is provided with a hollow stem 16 that extends to within close proximity of the entrance to passageway 14. An element 17 is concentrically disposed about the stem 16 in chamber 12. The bottom portion of chamber 12 is flared to provide a chamber 18 between element 17 and passageway 14. The body cap 15 is secured in a sealed relationship to the body member 10 by a screw 19 and gasket 20. The thickness of the gasket also controls the throat size 21 and thereby functions as a means for adjusting the distance between passageway 14 and stem 16.

The closure cap 15 is provided with a passageway 22 which is in alignment with passageway 14 for receiving a strand 24. The passageway 22 has a flared portion 23 to facilitate string up of the strand 24. In order to prevent false twisting of the strand, the element 17 is provided with a plurality of passageways concentrically arranged around the strand 24 and are parallel therewith.

The aspirating medium which may be a pressurized gas or liquid, is introduced from a supply source, not shown, into chamber 12 by means of pipe 26 and hole 27. Said medium enters chamber 12 and flows through the plurality of passageways 25 of element 17 in a streamline manner passing through throat 21 as a high velocity stream. The pressurized state of the aspirating medium is contingent upon several conditions and thus may be varied to suit the particular situation. Some factors which influence operating pressures are the degree of drawing required on the multifilaments of the strand, the type of polymer from which the filaments are made, whether the strand has previously been subjected to an orientation step and the resulting properties of the nonwoven product. The high velocity fluid stream emanating from throat 21 engages strand 24 with sufficient energy to draw the strand and forward same through passageway 14 into the traversing zone of the apparatus which is characterized by a diverging cavity 13 preferably at least 50 psig (3.55 Kg/cm^2 gauge).

Traversing of the multifilament strand 24 is accomplished by sequentially controlling a low pressure fluid medium that is supplied to diverging cavity 13, from a source not shown, by means of ports 28 and 29, and pipes 30 and 31, preferably at a pressure below about 40 psig (2.812 Kg/cm^2 gauge). A programmed rotating valve of a well known type may be advantageously utilized in series with pipes 30 and 31 to divert the control fluid media in an alternating manner prescribed by the desired traversing frequency. Alternatively to utilizing the programmed rotary valve, a fluid oscillator of the type disclosed in U.S. patent number 3,016,066 may be interconnected between ports 28 and 29 to generate self-excited oscillations to directionally control the reciprocatory action of the aspirated jet stream. However, this necessitates different length tubes for different traverse frequencies but coincident therewith obviates the need for a separate source of supply for the control fluid media.

The included angle β of diverging cavity 13 is determined by the desired length of the traverse stroke at the point of filament deposition, the distance between the traversing means and the deposition surface, and the degree of filament separation from the air stream at the deposition surface. The included angle β may range between approximately

15 and 90 degrees depending upon length of traverse stroke desired. Experience has shown that a distance of one to three feet between the diverging cavity 13 and the deposition surface has yielded satisfactory results.

Figure 1 depicts the arrangement of the apparatus utilized for the production of nonwoven webs wherein the combined aspirator and traverse assembly 40, indicated by the arrowed leader, is shown in a fixed relationship above a foraminous endless belt 32. Belt 32 is mounted for travelling by means of rolls 33, 34, and 35 with roll 33 being driven by a variable speed drive, not shown. A suction box 36 is provided immediately below belt 32 and the line of traverse to insure that the randomly dispersed filaments retain their respective positions after deposition. Evacuation of suction box 36 is accomplished by means of a pipe 37 and a vacuum source, not shown.

In an example, polyhexamethylene adipamide polymer was melt-spun into a 15 filament strand of 342 as-spun denier, said filaments were subsequently introduced into the combination aspirating and traversing mechanism assembly 40 wherein the strand 24 was subjected to air as the aspirating medium at a pressure of 90 psig. The filaments were attenuated to a total drawn denier of 90 by being drawn at a draw ratio of 3.8 and were simultaneously forwarded into the traversing zone by the aspirating jet stream. The control fluid pressure, also air, entering alternately through ports 28 and 29 was 30 psig, said fluid being sequentially supplied to provide a traverse rate of 10 strokes per minute. The traverse zone divergence angle β was 90° and the fixed distance residing between the traversing means and the continuous foraminous belt was approximately one foot. This provided for a traverse stroke length of 17 inches which yielded a web width of 17 1/4 inches. The linear speed of belt 32 was 18 inches per minute.

The nonwoven web produced was characterized by having a random filament distribution throughout. Physical testing of strips of the nonwoven web revealed that isotropism did not exceed 10 percent.

It is to be understood that the above example is for illustrative purposes only and is not to be construed as limiting the invention for it is contemplated that a strand having 1×10^6 total denier could be processed into webs by this invention. Too, it is contemplated that the aspirating streamline element 17 could be provided with a plurality of passageways 25 selectively arranged which would enable imparting a false twist to the multifilament strand 24 such that a coherent yarn bundle could be produced.

WHAT WE CLAIM IS:—

1. A method for depositing a multifilament strand on a travelling collecting surface in a randomly dispersed manner to produce a non-woven web structure having uniform thickness characterized by

(a) Extruding a fiber-forming material through a multiplicity of orifices to form a multifilament strand,

(b) advancing the strand through a combined aspirator and traversing means and on to the collecting surface with a high velocity jet or stream of fluid, and

(c) alternately diverting the direction of travel of the strand toward one side of the web or the collecting surface and then to the other with a jet or stream of fluid at a velocity which is less than the velocity of the fluid advancing the strand.

2. The method of Claim 1, characterized in that the strand is rapidly traversed by a pair of oppositely disposed sources of air supplied at a lower pressure than the fluid supplied to the aspirator zone and at intervals while the combined aspirator and traversing means remains in a stationary position.

3. The method of Claim 2, characterized in that the high velocity fluid is applied to the aspirator at a pressure of at least 50 psig (3.55 Kg/cm^2 gauge).

4. The method of Claim 3, characterized in that the low pressure control is below about 40 psig (2.812 Kg/cm^2 gauge).

5. Apparatus for traversing and depositing a multifilament strand on to a foraminous moving collection surface in a randomly dispersed manner to deposit the strand in the form of a nonwoven web structure having uniform density characterized by:

(a) a member having a chamber therein for receiving a pressurized fluid,

(b) a first passageway connecting said chamber with a portion of the member having outwardly diverging walls to form a traversing chamber,

(c) a second passageway coextensively aligned with said first passageway for receiving a strand.

(d) means for introducing into the chamber a pressurized fluid which envelops the strand within the first passageway and is discharged through the portion having diverging walls, and

(e) oppositely disposed inlets in the diverging walls for introducing fluid at a lower pressure alternately to one inlet and then the other whereby the strand is deflected first toward one side of the web or collecting surface and then to the other by said control fluid.

6. The apparatus of Claim 5, characterized in that the chamber is provided with an element having a plurality of holes concentrically arranged and parallel to the strand for communication between the opening into

the chamber and the first passageway to insure that false twist is not imparted to the strand.

7. The apparatus of Claim 5, characterized in that the included angle of divergence is between 15 and 90 degrees.

8. The apparatus of Claim 7, characterized in that the vertical length of the diverging wall of the traversing chamber is from 4 to 6 times greater than the diameter of the first passageway.

9. A method for depositing a multifilament strand on moving foraminous collection surface substantially as herein described with reference to the accompanying drawings.

10. A non woven web whenever produced by the method claimed in any one of claims 1 to 4 and 9.

11. Apparatus for forming a non woven web substantially as herein described with reference to and as illustrated in Figures 1 to 4 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1219921 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1.

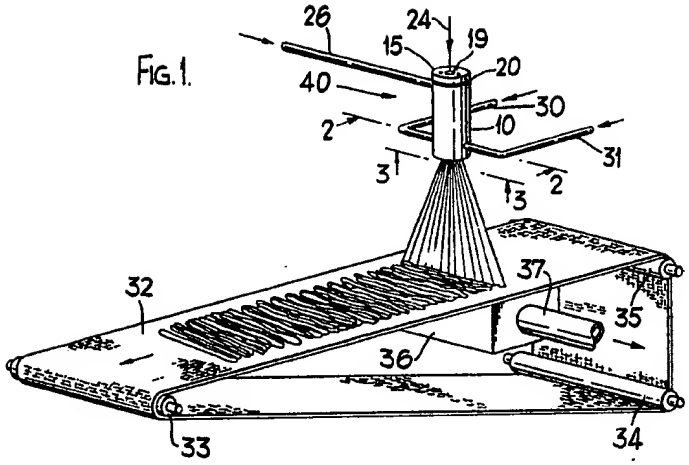

FIG. 2

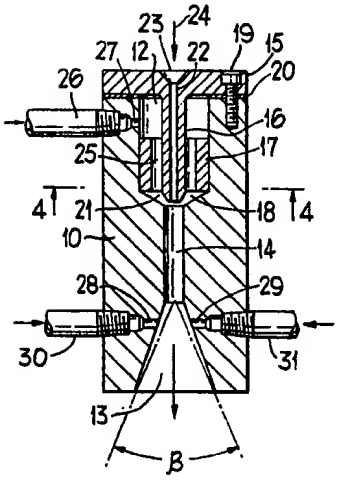

FIG. 3.

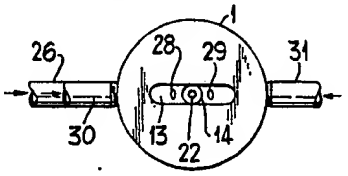

FIG. 4